

ACCIDENT

Aircraft Type and Registration:	Shadow Series CD, G-MYUS	
No & Type of Engines:	1 Rotax 503-2V piston engine	
Year of Manufacture:	1995 (Serial no: 257)	
Date & Time (UTC):	22 August 2012 at 1619 hrs	
Location:	Near Laverstock, Salisbury, Wiltshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Fatal)	Passengers - N/A
Nature of Damage:	Destroyed	
Commander's Licence:	National Private Pilot's Licence	
Commander's Age:	79	
Commander's Flying Experience:	164 hours (of which 164 were on type) Last 90 days - 2 hours Last 28 days - 1 hour	
Information Source:	AAIB Field Investigation	

Synopsis

The pilot had planned to carry out a local VFR cross-country flight from Old Sarum to Blandford Forum before returning to Old Sarum. Shortly after leaving the circuit, he contacted ATC and informed them that he was returning to the airfield. He gave no reason for his early return and there were no witnesses to the accident. Following concerns at the airfield that he had not arrived after the expected time, another club aircraft carried out a search and located the wreckage of G-MYUS in a field. The aircraft had struck the ground at a relatively high speed for the aircraft type, fatally injuring the pilot. It was possible that the pilot had become incapacitated in-flight, allowing the aircraft to enter a spiral dive.

History of the flight

The pilot was paraplegic and G-MYUS was adapted to enable operation using hand controls. He had booked the flight in advance and arrived at the flying club at Old Sarum about 1130 hrs. The aircraft had not been flown that day, so the pilot performed the daily inspection. The duty instructor pulled the aircraft out of the hangar and refuelled it to full tanks, providing an endurance of approximately 1 hour and 30 minutes.

The instructor and the pilot reviewed the weather prior to the flight which the instructor recalled as being good with isolated showers. They discussed the possibility of weather 'cells' developing and the need to remain clear of them. The pilot planned a one-hour solo flight along a route with which he was familiar, initially to Alderbury

and then following the A354 road to Blandford Forum before returning to Old Sarum.

Having performed the pre-flight inspection, the pilot was lowered into the cockpit using a specially adapted winch. The instructor secured the pilot's harness and carried out a final inspection of the aircraft, before pushing it up to the parking area. After engine start, the pilot taxied to the holding point of Runway 24. He departed at 1347 hrs making a left turn climbing towards Alderbury. However, at 1357 hrs the air/ground operator stated that the pilot reported on the radio "Alderbury for re-join with 24, left hand, QFE 1008" (Figure 1).

At 1405 hrs, the aircraft had not returned to Old Sarum, so the air/ground operator attempted to contact the aircraft but with no response. He confirmed with the instructor the intended routing and endurance and after an hour he contacted other local airfields; however, they had not had any contact with the aircraft either. As a result, the instructor and a colleague took off in another aircraft and subsequently located the wreckage of G-MYUS in a field, two miles to the south-east of the airfield. The pilot had been fatally injured.

Meteorological information

The weather over the UK on the day of the accident was characterised by a westerly airflow, which was slightly unstable over the southern part of the country. This meant there were rain showers¹ occurring in the Salisbury area, with the Met Office weather radar showing a moderate rain shower at 1430 hrs.

Conditions outside the rain showers were good with visibility around 30 km and cloud base at 2,500 ft and above. It is likely that within the rain showers the

visibility would have dropped to around 7 km and cloud base to approximately 2,000 ft. The surface wind was westerly at 10 to 15 kt and it was possible that in or near rain showers, the wind was gusting to around 25 kt.

Licence, medical and pathological information

The pilot held a valid NPPL, with a current medical declaration and was not taking any prescribed medication. Based on information provided by witnesses at the airfield, the pilot's demeanour prior to the flight was normal and in character.

The post-mortem confirmed the pilot died instantaneously of multiple injuries consistent with a non-survivable accident in a microlight aircraft. The aviation pathologist, who conducted the post-mortem, advised that the toxicology tests showed no evidence of drugs or exposure to carbon monoxide. However, he identified that the condition of the pilot's heart could potentially have led to incapacitation. His opinion was that "while there is no definite pathological evidence to indicate that it had done so, if other strands of the accident investigation indicate that pilot incapacitation was a likely cause of the accident, then this finding provides a possible explanation for such incapacitation."

The pilot's medical records indicated that the heart condition was likely to have been asymptomatic prior to the accident flight. The pathologist advised that it would only have been medically identifiable with specific, non-routine testing. There was no record of the pilot ever having undergone such tests, which are not required for the issue of an NPPL.

Footnote

¹ The rain showers were referred to by the instructor as 'cells'.

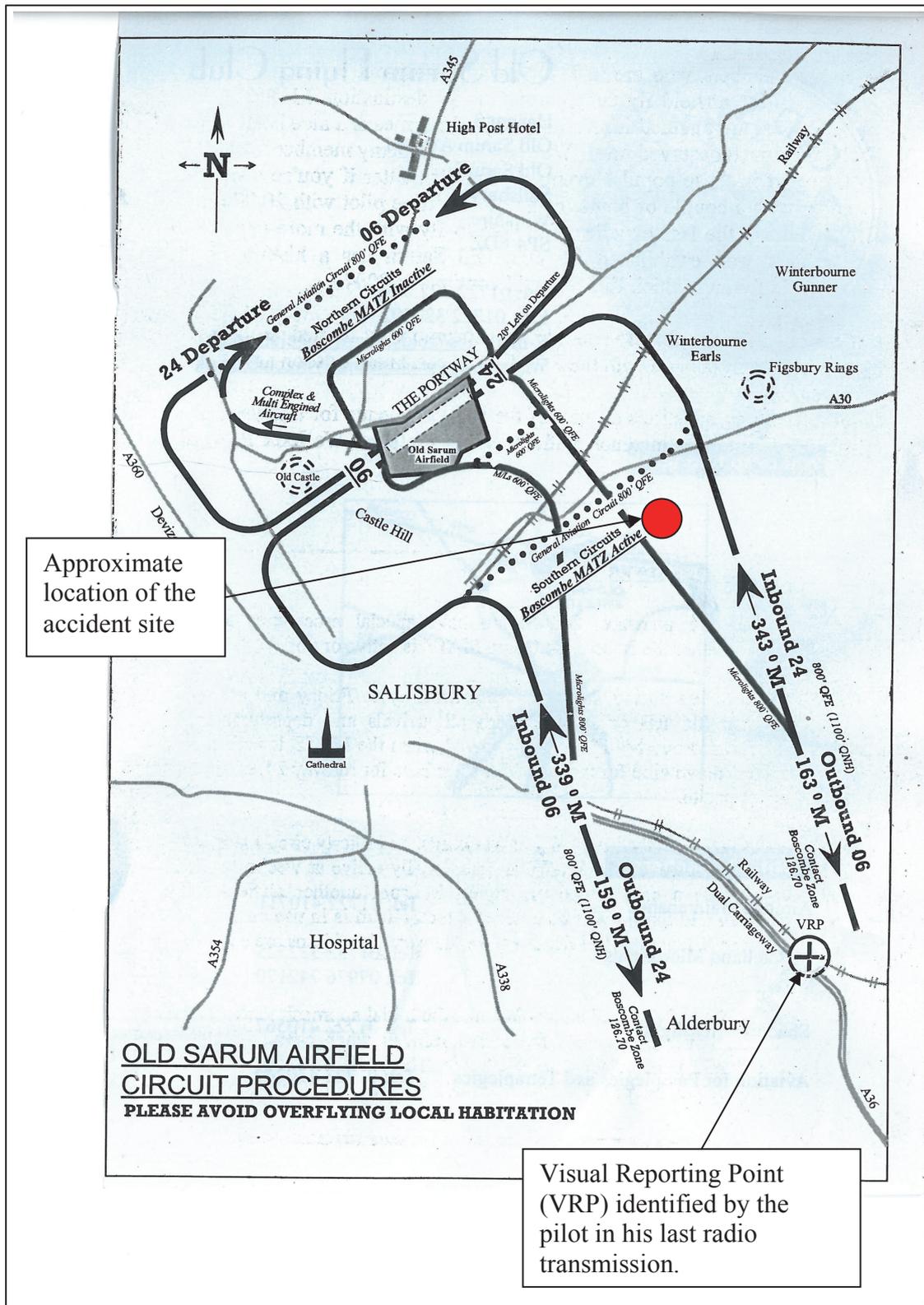


Figure 1

Airfield circuit diagram recovered from the wreckage

Aircraft description

The CFM Shadow is a two-seat, high-wing microlight aircraft, that can be home or factory built. The enclosed polycarbonate, Fibrelam and Glass Fibre Reinforced Plastic (GFRP) cockpit has a dual control, tandem-seat arrangement, but with only the front seat available for solo operation. Longitudinal and lateral control is provided by a right-hand sidestick and conventional pedal arrangement, with a throttle lever on the left side. The two-stroke rotax engine is located behind the rear seat and directly drives a three-blade pusher propeller. The vertical and horizontal stabilisers are located at the end of a tail boom that extends from the rear of the wing/cockpit interface. Twin endplate vertical fins extend above the horizontal stabiliser, with a small ventral fin and large rudder extending below it. The single, full width elevator is fitted with a small electrically operated trim tab. The wing is constructed predominantly from a polyester fabric, stretched over a plywood and aluminium spar structure, with Styrofoam formers providing the aerofoil and leading edge 'D' nose profile, with the leading edge skin constructed from GFRP. The aircraft is fitted with a fixed tricycle landing gear with a castoring nosewheel. The aircraft has a normal cruise speed of 65 kt and a V_{NE} of 94 kt.

Accident aircraft

G-MYUS was modified to allow operation by paraplegic pilots, with the conventional rudder pedals and throttle replaced by a multi-function hand control operating both the rudder and throttle functions. The brakes were also modified for hand operation, with brake levers fitted to both control sticks. The aircraft had been involved in an accident in 2006, when the pilot at the time had carried out an unsuccessful forced landing due to bad weather. The aircraft was significantly damaged during this accident, but had

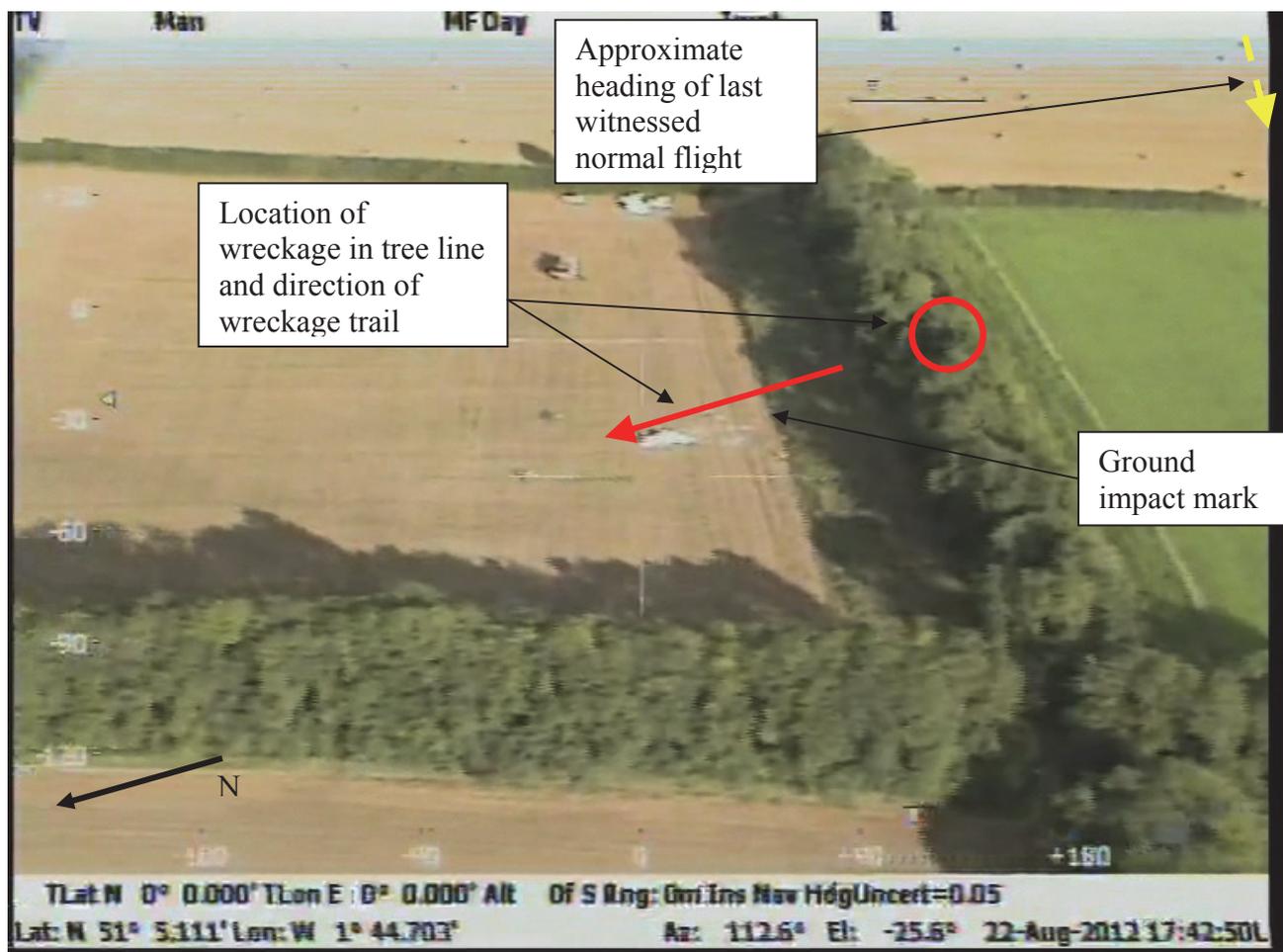
been repaired and returned to service using parts from a donor aircraft, under the approval of the BMAA.

Accident site and wreckage

The aircraft wreckage was located on the edge of a field adjacent to the field boundary, which consisted of a line of high trees, surrounded by tall, dense undergrowth. The accident took place following a period of dry, warm weather that had created a very hard, 'concrete like' surface to the field. As such, there was only one small ground mark caused by the initial impact.

A small section of wing leading edge structure was lodged in one of the trees, with associated damaged branches visible. Further small sections from the wing were scattered throughout the undergrowth on the same side of the tree line as the main wreckage. No items of wreckage were found on the opposite side of the tree line. The larger items of wreckage were distributed across the field, beginning at the edge of the cultivated section and extending from the ground impact mark on a bearing of 358°. (Figure 2)

The initial part of the trail was formed predominantly from sections of the wing leading edge 'D' nose structure, which had completely fragmented. The remaining wing and fuselage structure were located together some 10 metres away, inverted and pointing roughly perpendicular to the line of the wreckage trail. The cabin structure was heavily disrupted and detached, with only the seats and engine mount structure, with the engine attached, remaining connected to the wing and tail boom. The tail boom was bent upwards and to the left, whilst the horizontal stabiliser was damaged on the right side. The right main landing gear leg had been bent inwards under the aircraft. The wing structure itself was heavily disrupted, with the leading edge corner of the left wingtip crumpled inwards. Due to the extent



(Image courtesy of Wiltshire Police)

Figure 2

Aerial image of accident site

of the impact damage, it was not possible to determine the position of the flaps. The position of the trim tab on the elevator was approximately 5° nosedown from the neutral position.

The three propeller blades had separated from the propeller hub, but all blades were present in the wreckage trail. Rotational scuffmarks on one of the blades and paint transfer on the fuselage structure showed they had contacted during the ground impact, whilst the propeller was rotating at speed. The engine-cooling fan had been stripped of all its blades. As the engine directly drives the fan, this also confirmed the engine was operating at impact.

Whilst the wreckage was heavily disrupted, no evidence was identified during either the preliminary inspection on-site or the more detailed inspections following recovery of the wreckage to the AAIB's facilities, of a pre-existing defect or mechanical failure of the aircraft.

Aircraft performance and handling assessment

On 26 September 2012, a CAA light aircraft test pilot flew a Shadow CD microlight, G-MWVG, that was considered representative of the accident aircraft. The purpose of the flight was to assess the handling qualities of the aircraft, in particular its lateral, directional and spiral stability. The weather conditions at the time of the test flight were; surface wind 150° at 5 kt, visibility

in excess of 10 km, OAT 13°C with isolated showers but no turbulence outside of the showers.

The results of the series of tests determined that the aircraft had benign handling characteristics. The aircraft in a clean configuration at idle power stalled at 29 KIAS, preceded by light buffet and no wing drop. It had moderately positive longitudinal static stability² with noticeable force required on the side stick pitch control to execute a 10 kt speed change. Acceleration to V_{NE} in a dive from straight and level flight at 65 kt, even with full nosedown trim, was only achievable with a constant forward stick force measured at approx 10 kgf. Lateral stability was also positive and the aircraft had positive directional stability.

The aircraft exhibited a weak divergent spiral mode when displaced from the wings level attitude by more than 10°. With cruise power set, the aircraft was more likely to diverge to the left, whereas with idle power set, the aircraft tended to deviate to the right. In both cases, if the pilot did not take corrective action, the aircraft entered a gently tightening spiral dive. Without intervention, the spiral dive resulted in steadily increasing airspeed, yaw rate, angle of bank and rate of descent in the nosedown attitude. The tests were discontinued at 80 KIAS in order to prevent the propeller exceeding its maximum rpm limit. However, the test pilot considered the aircraft would have achieved and possibly exceeded its V_{NE} had corrective action not been taken.

Analysis

The pilot was properly licensed and qualified to conduct the flight and held a valid medical declaration. No evidence of a pre-impact defect or mechanical failure of the aircraft was identified during the investigation.

Footnote

² The stability of an aircraft in the longitudinal or pitching axis under steady flight conditions.

The pilot had intended to fly for approximately one hour but elected to return after only 10 minutes. He did not state the reason for his return in his radio transmission. There was a moderate rain shower in the general area that may have led him to make this decision, having discussed this eventuality with his instructor prior to the flight, or there may have been some other reason not identifiable to the investigation.

The degree of disruption to the aircraft structure and the severity of the injuries sustained by the pilot indicated a relatively high impact speed for the aircraft type. Based on the pilot's stated intention and the position of the wreckage, the pilot appeared to be flying on an extended base leg to rejoin for Runway 24 at Old Sarum. At a point along this route, the aircraft deviated to the right of track, lost height and gained airspeed, before it struck the branches of a tree in the tree line forming the boundary of a small field. Given the minor damage evident in the tree line and the small piece of leading edge wing structure that was retained in the branches, it is likely that only the right wing struck the top of the trees, consistent with the aircraft having a degree of right wing low bank angle and a nosedown attitude. The aircraft's right wingtip then struck the ground, followed by the right side of the cockpit nose and fuselage. The aircraft continued to rotate in a cartwheel motion resulting in the left wingtip striking the ground. Wreckage debris was projected across the field, with the wing and remaining fuselage travelling laterally to their final resting position.

The flight tests demonstrated that even with full nosedown trim, the aircraft's inherent static stability would have required that it be held in a dive by a continuous nosedown sidestick control input force of nearly 10 kgf, to achieve the impact speed estimated from the physical evidence. The investigation did not identify any evidence to suggest this was a likely

scenario. Equally, the aircraft had probably not entered a stall as the final flight path and accident site evidence did not match the stall characteristics of the aircraft type, as demonstrated during the flight test.

The flight test demonstrated that the most likely manner in which the aircraft achieved the impact speed estimated, without an intentional input on the controls, was a spiral dive. This would also be consistent with the deviation seen from the apparent intended flight path and the ground impact sequence identified. Under normal circumstances, given the benign handling characteristics of the aircraft, it was well within the pilot's ability to recover from an incipient spiral dive. However, without pilot intervention the dive would continue to develop, with the aircraft gaining airspeed and losing height until it struck the ground. The most likely explanation for a lack of intervention by the pilot would be incapacitation. Whilst the post-mortem findings were not able to offer conclusive evidence in support of this conclusion, the reported condition of the pilot's heart did offer a possible cause.

To initiate the spiral dive the aircraft needed to be displaced by 10° or more from wings level. This could have occurred due to a gust of wind or turbulence. However, given the functionality of the sidestick controls, it is also feasible that, had the pilot become incapacitated with his hands on the controls, this could have resulted in an inadvertent right rudder and/or right roll control input inducing the required initial angle of bank. This may also have increased the rate at which the spiral dive developed.

Conclusion

It was possible that the pilot, having elected to return to the airfield, subsequently became incapacitated. It is likely the aircraft then entered a spiral dive, from which it was not recovered. The aircraft eventually struck trees followed by the ground, with the impact forces generated being non-survivable. The incapacitation may have been caused by the condition in the pilot's heart, which appeared previously to have been asymptomatic, and for which his category of pilot's licence did not require him to be tested.